Tatemi SHIMIZU*: Cytogeographical notes on *Chrysanthemum Zawadskii* Herb. and its allies

清水建美*: イワギク群の分布並びに染色体数について

In his previous paper[1], the writer reported the somatic chromosome number (54) of *Chrysanthemum Zawadskii* growing in the limestone area of the northern part of the Kitagami Mountain Range in Honshû of Japan. Since then, the habitats and the chromosome number of this species as well as its morphological variation have been examined on the basis of materials from several additional localities in Japan. The present paper is intended to report the result of these studies and to offer the writer's opinion on the phytogeographical status of *C. Zawadskii* and its allies.

Chromosome numbers

The materials of *C. Zawadskii*-group, investigated cytologically in the course of this study, came to the writer's hands from the following five localities in Japan: the foot of Mt. Hakusan, Pref. Ishikawa, Honshû; Mt. Dôdake and Mt. Shiraiwa, both in Pref. Miyazaki, Kyûshû; Mt. Noke-eboshi, Pref. Kumamoto,

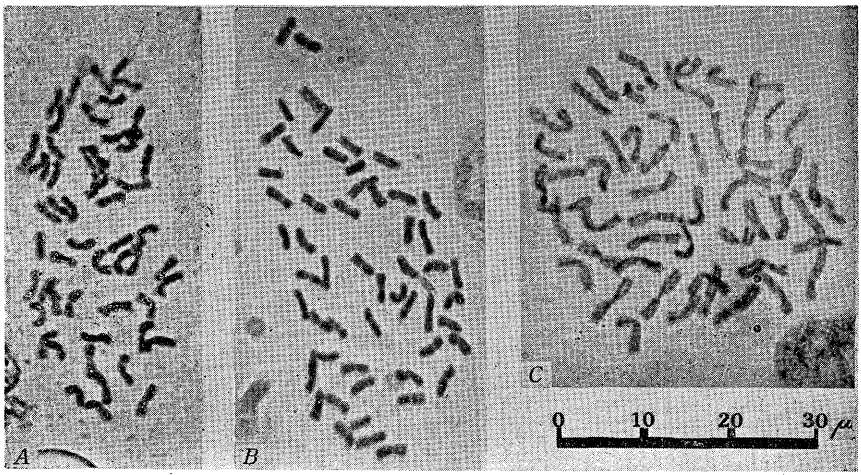

Fig. 1. Somatic chromosomes of *C. Zawadskii*-group of Japan.
A. var. *Zawadskii* from Mt. Dôdake. B. var. *Zawadskii* from Mt. Noke-eboshi.
C. var. *latilobum* from Isl. Hirato.

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Kyûshû; and Isl. Hirato, Pref. Nagasaki, Kyûshû. The plants from the last mentioned locality are *C. Zawadskii* var. *latilobum*, and the rests are referable to var. *Zawadskii*. In our country, they are restricted to open gravelly places of rocks, limestone or andesite (Tab. 1).

Chromosomes were counted in root tip cells by squashing method, in which 0.002 mol oxyquinoline and 1 per cent acetic orcein solutions were used.

The result was that, indifferent with their morphological variation, the plants from the five localities mentioned above were all hexaploid, 2n=54 (Fig. 1). This fact is accordant with the results obtained in *C. Zawadskii*-group from two other localities in Honshû of Japan; Pref. Iwate and Pref. Shimane. Thus, chromosome numbers so far reported on *C. Zawadskii* and its allies are as follows (Tab. 1).

Tab. 1. Chromosome numbers and habitats of *C. Zawadskii* and its allies.

Names	Localities	Habitats	n	2n	Authors
C. sibiricum	Korea: Kôshû, Prov. Chhung-chheng	?	27		Shimotomai and Hara[2]
C. Zawadskii	Siberia	?	36		Shimotomai[3]
C. rubellum	China	?		63	Dowrick[4]
C. erubescens	unknown	?		54	Dowrick[5]
C. Zawadskii var. *latilobum*	Mongolia	?	9		Shigenaga ex Kitamura[6]
C. Zawadskii, narrowly lobed race	Japan: Akka, Pref. Iwate	Limestone 400m alt.		54	Shimizu[1]
C. Zawadskii, broadly lobed race	Japan: Iwaizumi, Pref. Iwate	Limestone 400m alt.		54	Shimizu[1]
C. Zawadskii	Japan: Mt. Senjô, Pref. Shimane	Andesite 600m alt.		54	Shimizu[7]
C. Zawadskii	Japan: Mt. Hakusan, Pref. Ishikawa	Andesite 800m alt.		54	
C. Zawadskii	Japan: Mt. Dôdake, Pref. Miyazaki	Limestone 1300m alt.		54	
C. Zawadskii	Japan: Mt. Shiraiwa, Pref. Miyazaki	Limestone 1600m alt.		54	
C. Zawadskii	Japan: Mt. Noke-eboshi, Pref. Kumamoto	Limestone 1000m alt.		54	
C. Zawadskii var. *latilobum*	Japan: Insl. Hirato, Pref. Nagasaki	Andesite[8]		54	

Discussion

As is generally known, members of *C. Zawadskii*-group are highly variable in length of stems, shape and thickness of leaves, size and colour of ray flowers, degree of pubescence of stems and leaves, and so on. Corresponding with such variability, many a scientific name has been proposed for various forms of this group. Above all, the differences in leaf shape were at first adopted as discriminating features, and in these respects the present-day taxonomists distinguished such varieties as var. *Zawadskii* and var. *latilobum*.

Typical *C. Zawadskii* from the west Carpathians, the chromosome number of which is unknown, has always narrowly bipinnatisect leaves (Fig. 2, H; also, see

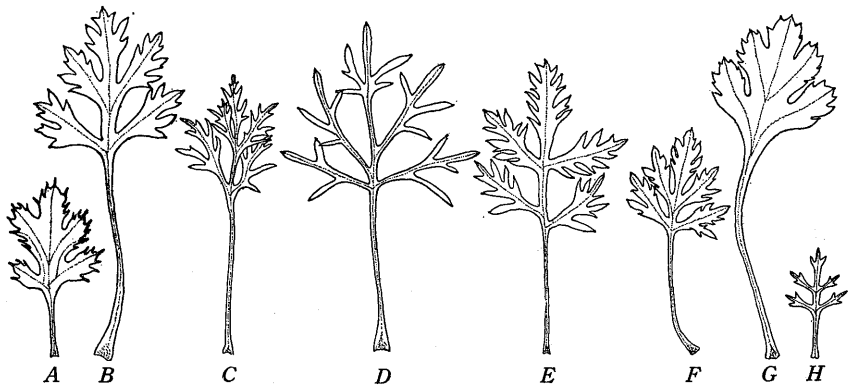

Fig. 2. Leaf shape of *C. Zawadskii*-group.
A. From Mongolia. B. From Mt. Hakusan. C. From Mt. Senjô. D. From Mt. Dôdake. E. From Mt. Shiraiwa. F. From Mt. Noke-eboshi. G. From Insl. Hirato. H. From the Carpathians. ×1/2.

Pax' figure[9]). In 1867, Herder[10]) suggested that "das *C. Zawadskii* Herb. ist nach dem uns vorliegeden Exemplare nichts anders als *Leucanthemum sibiricum* DC." Following Herder's suggestion, Trautvetter[11]), in 1883, reduced Siberian *L. sibiricum* var. *acutilobum* DC. (=*C. sibiricum* Fisch. ex Turcz.) to a synonym of *C. Zawadskii*. Typical *L. sibiricum* DC. (=*C. sibiricum* var. *latilobum* Komar.) is a form with broadly pinnatilobed leaves. Shimotomai and Hara[2]) reported the chromosome number of *C. sibiricum*, but it is doubtful whether their material represents correctly var. *acutilobum* type or not. According to Shimotomai, his octoploid plant, cultivated in the Berlin-Dahlem Botanical Garden as *C. Zawadskii* and investigated by him, is originated from Siberia. In spite of Trautvetter's

arrangement, Pax[9] regarded *C. Zawadskii* to be endemic in the limestone area of the west Carpathians, but it is highly probable that the Siberian plant, *C. sibiricum*, had been dealt with in Germany as the same with *C. Zawadskii* before Shimotomai's presentation in 1937. Therefore, the octoploid Siberian plant mentioned is likely to have a form with narrowly bipinnatisect leaves. Dowrick's plant with 63 chromosomes in diploid phase, *C. rubellum*, was a garden species introduced from Chiha[4]. He informed the writer that its origin was unknown. The materials of *C. erubescens* used by Dowrick for chromosome counting is also obscure in origin. This species depends on *Pyrethrum sinense* var. *sinense* Maxim. originally reported as being in south Manchuria, north China and south Mongolia[12]. Sealy[13], in 1938, investigated the relation between *C. rubellum*, *C. erubescens* and *C. Zawadskii* and reported that *C. erubescens* was distributed in south Manchuria, Chihli, Shansi, Kansu (?), Szechuan and south Mongolia, and was especially abundant in Chihli. Thus, it is most likely that Dowrick's hexaploid plant came from north China. This is the race with less pinnatilobed leaves, more or less smaller ray flowers of pink colour and much more ramose habit compared with *C. Zawadskii* var. *latilobum*. Shigenaga's plant from Mongolia, the chromosome number of which was proved to be 9 in haploid phase, is closely related to *C. erubescens*, having small leaves pinnatified into aristate-serrate lobes (Fig. 2, A). This character seems to be peculiar to the Mongolian plants among *C. Zawadskii* complex. In the Japanese plants studied by the writer, flowers are mostly white, stems little ramose and pubescent only in the upper part. The leaves are narrowly bipinnatisect to broadly pinnatilobed (Fig. 2; B–G).

From the cytotaxonomical point of view, *C. Zawadskii*-complex may be grouped into at least three geographical races: the east European and south Siberian octoploid race, the Mongolian diploid race, and the Far Eastern hexaploid race. The first one needs to be examined more intensively hereafter, for no cytological data have been available regarding the west Carpathian plants and those of linking areas between the Carpathians and south Siberia, such as "Petschora[10]", "Samojedenland[11]" and Tobolsk[14]. The tetraploid race of *C. Zawadskii*-complex may be found in north China, south Manchuria or north Korea, where the three races mentioned above are supposed to be growing together. *C. rubellum* may be a hybrid originated in these districts.

The leaf shape of the *C. Zawadskii*-complex, on the other hand, seems to be independent of its origin. The reason is that, although the Japanese plants are

distributed much discontinuously throughout Honshû, Shikoku and Kyûshû, and have leaves of various shapes, they are uniform in chromosome number. In short, they are relic polyploid species and their leaf shape is strongly variable polytopically. The group shoud be reexamined taxonomically, because the Far Eastern plants, the Mongolian plants and the European and Siberian plants might be of different origin.

Summary

The Japanese plants regarded taxonomically as *Chrysanthemum Zawadskii* and var. *latilobum* were proved to be hexaploid, 2n=54. This fact has nothing to do with their habitats and morphological diversity. From the cytogeographical point of view, three geographical races are recognizable among *C. Zawadskii*-complex: the east European and south Siberian race (octoploid), the Mongolian race (diploid), and the Far Eastern race (hexaploid).

The writer wishes to express his hearty thanks to Prof. S. Kitamura and Prof. M. Tagawa for their constant direction and to Dr. G. J. Dowrick for his good suggestions.

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日本産のイワギクとチョウセンノギクは共に6倍体 (2n=54) であることが分った。イワギク群には東ヨーロッパ, 南シベリアに8倍体, 蒙古に2倍体と極東に6倍体が知られている。